THE DIVINING ROD

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ARTHUR J. ELLIS

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DEPARTMENT OF THE INTERIOR
FRED A. SEATON, Secretary

UNITED STATES GEOLOGICAL SURVEY
Thomas B. Nolan, Director

Water-Supply Paper 416

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A HISTORY OF WATER WITCHING

WITH A BIBLIOGRAPHY

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INTRODUCTORY NOTE.

By O. E. Meinzer.

The use of a forked twig, or so-called divining rod, in locating minerals, finding hidden treasure, or detecting criminals is a curious superstition that has been a subject of discussion since the middle of the sixteenth century and still has a strong hold on the popular mind, even in this country, as is shown by the large number of inquiries received each year by the United States Geological Survey as to its efficacy, especially for locating underground water, and the persistent demands that it be made a subject of investigation by the Survey. The bibliography shows that a truly astonishing number of books and pamphlets have been written on the subject. The purpose of the present brief paper is not to add another contribution to this enormous volume of uncanny literature but merely to furnish a reply to the numerous inquiries that are continually being received from all parts of the country. The outline of the history of the subject presented in the following pages will probably enable most honest inquirers to appreciate the practical uselessness of "water witching" and other applications of the divining rod, but those who wish to delve further into the mysteries of the subject are referred to the literature cited in the bibliography, in which they will find reports in painful detail of exhaustive investigations and pseudo-investigations of every phase of the subject and every imaginable explanation of the supposed phenomena.

It is doubtful whether so much investigation and discussion have been bestowed on any other subject with such absolute lack of positive results. It is difficult to see how for practical purposes the entire matter could be more thoroughly discredited, and it should be obvious to everyone that further tests by the United States Geological Survey of this so-called "witching" for water, oil, or other minerals would be a misuse of public funds.

A large number of more complicated devices for locating water or other minerals are closely related to the forked twig. A favorite trick for appealing to uneducated persons and yet making specific disproof impossible is to give as the working principle of such a device some newly discovered and vaguely understood phenomenon, as, for example, radioactivity. Many such devices have been in existence

since the seventeenth century, and almost without exception the claims that are made for them are very great. If any genuine instrument were invented its merits would no doubt in time become well recognized, as have those of other real inventions. The magnetic needle used in detecting iron ore is, of course, not included in this category of spurious instruments.

It is by no means true that all persons using a forked twig or some other device for locating water or other mineral are intentional deceivers. Some of them are doubtless men of good character and benevolent intentions. However, as anything that can be deeply veiled in mystery affords a good opportunity for swindlers, there can be no reasonable doubt that many of the large group of professional finders of water, oil, or other minerals who take pay for their "services" or for the sale of their "instruments" are deliberately defrauding the people, and that the total amount of money they obtain is large.

To all inquirers the United States Geological Survey therefore gives the advice not to expend any money for the services of any "water witch" or for the use or purchase of any machine or instrument devised for locating underground water or other minerals.

NOTE FOR 1934 REPRINT, by O. E. Meinzer.—Since this paper was first published, in 1917, much progress has been made in the development of geophysical instruments and methods which give information that is useful in the study of underground conditions by specially trained scientists. These instruments and methods are quite distinct from the so-called "water finders", described on pages 23 to 25 of this paper, which are not recommended by the Geological Survey.

The subject of geophysical methods of prospecting is complicated and highly technical. Those interested in relatively short and simple descriptions of these methods are referred to the following articles:

Mason, Max, Geophysical exploration for ores: Geophysical prospecting, pp. 9–43, 21 figs., Am. Inst. Min. and Met. Eng., 1929.

Heiland, C. A., Geophysical methods of prospecting; principles and recent successes: Colorado School of Mines Quart., vol. 24, no. 1, 166 pp., March 1929.

Barton, D. C., Geophysical prospecting for oil: Am. Assoc. Petroleum Geologists Bull., vol. 14, no. 2, pp. 201–226, February 1930.

Barton, D. C., and Summers, E. B., Review of the geophysical methods of prospecting: Geog. Review, vol. 20, no. 2, pp. 288–300, April 1930.

More extended and technical discussions are given in the following publications:

Eve, A. S., and Keyes, D. A., Geophysical methods of prospecting: U.S. Bur. Mines Technical Paper 420, 26 pp., 27 figs., 1927.

Ambronn, Richard, Elements of geophysics as applied to explorations for minerals, oil, and gas (trans. by Margaret C. Cobb), 372 pp., New York, McGraw-Hill Book Co., 1928.

American Institute of Mining and Metallurgical Engineers, Discussion of the papers on geophysical prospecting presented at the New York meeting, February 1928: Am. Inst. Min. and Met. Eng. Tech. Pub. 130, 31 pp., October 1928.

NOTE FOR 1938 REPRINT, by O. E. Meinzer.—See also the group of six papers on the use of geophysical methods in ground-water studies published in the American Geophysical Union Transactions, 1937, pages 385–409, 574–588.

THE DIVINING ROD: A HISTORY OF WATER WITCHING.

By Arthur J. Ellis.

FORM OF THE DIVINING ROD.

In its most familiar form the so-called divining rod is a forked twig, one fork of which is usually held in each hand in such a manner that the butt end of the twig normally points upward (figs. 1 and 2). The supposition is that when carried to a place beneath which water or other minerals lie, the butt end will be attracted downward, or, according to some diviners, will whirl round and round. There are many modifications in both the form and the manipulation of the device. For instance, a straight twig may be held at the small end, allowing the butt end to bob up and down, the number of bobs being taken to indicate the depth to water or ore in fathoms or feet or other common unit of measure.

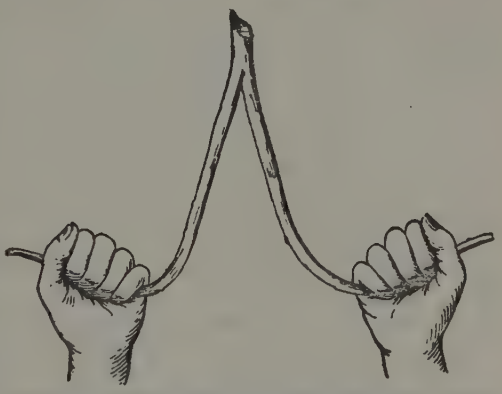

Figure 1.—Ordinary divining rod held in the usual manner.

The opinion as to the kind of wood of which the twig should consist has differed greatly at different times and places, but peach, willow, hazel, and witch hazel are common favorites. By some diviners the twig is cut indiscriminately from any kind of tree, or the device is made of metal or is some common implement, such as a buggy whip. Formerly incantations were used in connection with the divining rod.

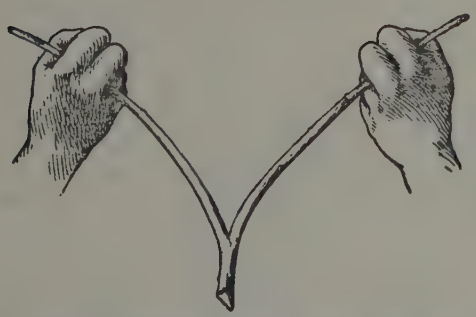

Figure 2.—Less common manner of holding the divining rod.

Some diviners appear to pass into abnormal or psychical states and have muscular spasms, such as occur in cases of hysteria, which, it is contended, can not be repeated at will by the

diviner when he returns to a normal state. Under such conditions the twig may not only rotate, but one fork may be completely twisted off by the force with which it is driven round and round.

Divining rods have been put to a wide variety of uses since the superstition first became popular, and it is not uncommon even at the present time to find them used by a single person to obtain diverse results, among which there is no conceivable relation. For example, Henri Mager purports to use the rod to detect the presence of water and ores and to measure their depth below the surface, to analyze water and ores, to determine the directions of the cardinal points, to measure the height of trees, and to perform other marvels. (See p. 23.) In tracing the history of the subject it is found that divining rods have been used for all of the following purposes: (1) To locate ore deposits, (2) to discover buried or hidden treasure, (3) to find lost landmarks and reestablish property boundaries, (4) to detect criminals, (5) to analyze personal character, (6) to cure diseases, (7) to trace lost or strayed domestic animals, (8) to insure immunity against ill fortune when preserved as a fetish, (9) to locate well sites, (10) to trace the courses of underground streams, (11) to determine the amount of water available by drilling at a given spot, (12) to determine the depth at which water or ores occur, (13) to determine the direction of cardinal points, (14) to determine the heights of trees, and (15) to analyze ores and waters.

FIGURE 3.—Various old types of divining rods and the ways in which they were held. (After Vallemont, 1693.)

ORIGIN OF THE DIVINING ROD.

The origin of the divining rod is lost in antiquity. Students of the subject have discovered in ancient literature many more or less vague references to it, and though it is certain that rods or wands of some kind were in use among ancient peoples for forecasting events and searching for lost objects, and in occult practices generally, little

is known of the manner in which such rods were used or what relation, if any, they may have to the modern device. The "rod" is mentioned many times in the Bible in connection with miraculous performances, especially in the books of Moses. The much-quoted passage describing the "smiting of the rock" (Numbers xx, 9–11) has been regarded by enthusiasts of water witching as a significant reference to the divining rod,[1] as have also the following passages: "My people ask council at their stocks, and their staff declareth unto them" (Hosea iv, 12); and "The king of Babylon stood at the parting of the way, at the head of two ways, to use divination; he made his arrows bright," etc. (Ezekiel xxi, 21).

The following paragraphs are quoted from Rossiter Raymond's essay[2] on the use of rods for divination:

> The Scythians, Persians, and Medes used them. Herodotus says that the Scythians detected perjurers by means of rods. The word rhabdomancy,[3] originated by the Greeks, shows that they practiced this art; and the magic power of the rods of Minerva, Circe, and Hermes or Mercury is familiar to classical students. The lituus of the Romans, with which the augurs divined, was apparently an arched rod. Cicero, who had himself been an augur, says, in his treatise on divination, that he does not see how two augurs, meeting in the street, could look each other in the face without laughing. At the end of the first book of this treatise he quotes a couplet from the old Latin poet Ennius, representing a person from whom a diviner had demanded a fee as replying to this demand, "I will pay you out of the treasures which you enable me to find." * * *
>
> Marco Polo reports the use of rods or arrows for divination throughout the Orient, and a later traveler describes it among the Turks. Tacitus says that the ancient Germans used for this purpose branches of fruit trees. One of their tribes, the Frisians, employed rods in church to detect murderers. Finally, if we may trust Gonsalez de Mendoza, the Chinese, who seem to have had everything before anybody else, used pieces of wood for divination.
>
> Thus we perceive that the application of the divining rod in historical antiquity was mainly or wholly moral—that is, it was employed to detect guilt, decide future events, advise courses of action, etc. There are but two passages which have been quoted to prove its use for physical purposes; one from Ctesias (Apud phot. bibl. cod.), who speaks of a rod of the wood Parebus, which attracted gold, silver, other metals, stones, and several other things; the other from Cicero (De Officiis, lib. I), who says, "If we could obtain with the so called divine rod everything pertaining to food and clothing (ad victum cultumque)," etc.[4]
>
> On the other hand, the silence of many authors is significant, as Chevreul has pointed out. Varro does not mention the use of the rod for the discovery of subterranean waters or metals. Vitruvius, discussing the means of discovering springs, says nothing of it. Pliny, in Book XXX of his Natural History, omits it from his enumeration of magical arts and methods, and in Book XXXI, describing (after Vitruvius) the means of discovering springs, and Book XXXIII, describing explorations for metals, is equally silent concerning it. Columella, Palladius, and in the sixth century Cassio-

[1] Latimer, Charles, The divining rod, p. 20, 1876.

[2] Raymond, R. W., The divining rod: Am. Inst. Min. Eng. Trans., vol. 11, pp. 415–416, 1883. See also U. S. Geol. Survey Mineral Resources, 1882, pp. 610–626, 1883.

[3] Rhabdomancy, from the Greek ῥάβδος, rod, and μαντεία, divination, is the practice of searching for springs, well sites, precious metals, and other things concealed in the earth by means of a divining rod.

[4] This reference in complete form reads as follows: "If all that is needful for our nourishment and support arrives to us by means of some divine rod, as people say, then each of us, free from all care and trouble, may give himself up to the exclusive pursuit of study and science."

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dorus are likewise dumb, though the latter in one of his epistles (Theodoric, LIII) extols the utility of the professional water discoverers.

Whatever significance one may attach to such references as those cited above, no conclusive evidence has been found of the use of the divining rod as it is now known earlier than the first half of the sixteenth century. What is believed to be the first published description of the rod is contained in Georgius Agricola's "De re metallica," which was begun about 1533 and was published in 1556. There is a striking similarity between some of the ideas expressed in this account and some of those now held regarding the rod and its use, which, it is believed, justify its quotation. The following paragraphs are quoted from the Hoover translation:[1]

There are many great contentions between miners concerning the forked twig, for some say that it is of the greatest use in discovering veins, and others deny it. Some of those who manipulate and use the twig first cut a fork from a hazel bush with a knife, for this bush they consider more efficacious than any other for revealing veins, especially if the hazel bush grows above a vein. Others use a different kind of twig for each metal, when they are seeking to discover the veins, for they employ hazel twigs for veins of silver; ash twigs for copper; pitch pine for lead and especially tin, and rods made of iron and steel for gold. All alike grasp the forks of the twig with their hands, clenching their fists, it being necessary that the clenched fingers should be held toward the sky in order that the twig should be raised at that end where the two branches meet. Then they wander hither and thither at random through mountainous regions. It is said that the moment they place their feet on a vein the twig immediately turns and twists, and so by its action discloses the vein; when they move their feet again and go away from that spot the twig becomes once more immobile.

The truth is, they assert, the movement of the twig is caused by the power of the veins, and sometimes this is so great that the branches of trees growing near a vein are deflected toward it. On the other hand, those who say that the twig is of no use to good and serious men, also deny that the motion is due to the power of the veins, because the twig will not move for everybody, but only for those who employ incantations and craft. Moreover, they deny the power of a vein to draw to itself the branches of trees, but they say that the warm and dry exhalations cause these contortions. Those who advocate the use of the twig make this reply to these objections: When one of the miners or some other person holds the twig in his hands, and it is not turned by the force of the veins, this is due to some peculiarity of the individual, which hinders and impedes the power of the vein, for since the power of the vein in turning and twisting the twig may be not unlike that of a magnet attracting and drawing iron toward itself, this hidden quality of a man weakens and breaks the force, just the same as garlic weakens and overcomes the strength of a magnet. For a magnet smeared with garlic juice can not attract iron, nor does it attract the latter when rusty. Further, concerning the handling of the twig, they warn us that we should not press the fingers together too lightly, nor clench them too firmly, for if the twig is held lightly they say that it will fall before the force of the vein can turn it; if, however, it is grasped too firmly the force of the hands resists the force of the veins and counteracts it. Therefore, they consider that five things are necessary to insure that the twig shall serve its purpose: of these the first is the size of the twig, for the force of the vein can not turn too large a stick; secondly [illegible] is the shape of the twig, which must be forked or the vein can not turn it; thirdly, the power of the vein which has the nature to turn it; fourthly, the manipulation of the twig; fifthly, the absence of

[1] Agricola, Georgius, De re metallica, translated from first Latin edition of 1556 by H. C. and L. H. Hoover, pp. 38-41, 1912.

impeding peculiarities. These advocates of the twig sum up their conclusions as follows: If the rod does not move for everybody, it is due to unskilled manipulation or to the impeding peculiarities of the man which oppose and resist the force of the veins, as we said above, and those who search for veins by means of the twig need not necessarily make incantations, but it is sufficient that they handle it suitably and are devoid of impeding power; therefore, the twig may be of use to good and serious men in discovering veins. With regard to deflection of branches of trees they say nothing and adhere to their opinion.

Since this matter remains in dispute and causes much dissension amongst miners, I consider it ought to be examined on its own merits. The wizards, who also make use of rings, mirrors, and crystals, seek for veins with a divining rod shaped like a fork; but its shape makes no difference in the matter—it might be straight or of some other form—for it is not the form of the twig that matters [see fig. 3], but the wizard's incantations which it would not become me to repeat, neither do I wish to do so. The ancients, by means of the divining rod, not only procured those things necessary for a livelihood or for luxury, but they were able also to alter the forms of things by it; as when the magicians changed the rods of the Egyptians into serpents, as the writings of the Hebrews relate; and as in Homer, Minerva with a divining rod turned the aged Ulysses suddenly into a youth and then restored him back again to old age; Circe also changed Ulysses' companions into beasts, but afterward gave them back again their human forms; moreover, by his rod, which was called "Caduceus," Mercury gave sleep to watchmen and awoke slumberers. Therefore it seems that the divining rod passed to the mines from its impure origin with the magicians. Then when good men shrank with horror from incantations and rejected them, the twig was retained by the unsophisticated common miners, and in searching for new veins some traces of these ancient usages remain.

But since truly the twigs of the miners do move, albeit they do not generally use incantations, some say this movement is caused by the power of the veins, others say that it depends on the manipulation, and still others think that the movement is due to both these causes. But, in truth, all those objects which are endowed with the power of attraction do not twist things in circles, but attract them directly to themselves; for instance, the magnet does not turn the iron but draws it directly to itself, and amber rubbed until it is warm does not bend straws about, but simply draws them to itself. If the power of the veins were of a similar nature to that of the magnet and the amber, the twig would not so much twist as move once only, in a semicircle, and be drawn directly to the vein, and unless the strength of the man who holds the twig were to resist and oppose the force of the vein the twig would be brought to the ground; wherefore, since this is not the case, it must necessarily follow that the manipulation is the cause of the twig's twisting motion. It is a conspicuous fact that these cunning manipulators do not use a straight twig but a forked one cut from a hazel bush or from some other wood equally flexible, so that if it be held in the hands, as they are accustomed to hold it, it turns in a circle for any man wherever he stands. Nor is it strange that the twig does not turn when held by the inexperienced, because they either grasp the forks of the twig too tightly or hold them too loosely. Nevertheless, these things give rise to the faith among common miners that veins are discovered by the use of twigs, because whilst using these they do accidentally discover some; but it more often happens that they lose their labour, and although they might discover a vein, they become none the less exhausted in digging useless trenches than do the miners who prospect in an unfortunate locality. Therefore a miner, since we think he ought to be a good and serious man, should not make use of an enchanted twig, because if he is prudent and skilled in the natural signs he understands that a forked stick is of no use to him, for, as I have said before, there are the natural indications of the veins which he can see for himself without the help of twigs. So if Nature or chance should indicate a locality suitable for mining, the miner should dig his trenches there; if no vein appears he must dig numerous trenches until he discovers an outcrop of a vein.

There are two accounts of earlier date than "De re metallica" which are mentioned in most histories of the divining rod. One of these accounts is contained in the "Novum testamentum" of Basilius Valentinus, a Benedictine monk of the fifteenth century, who devoted seven chapters of the second book of his work to a didactic account of the use of the divining rod. But there is some confusion as to the date and as to the authorship of this book, and Raymond points out that the existence even of Basilius Valentinus is not beyond doubt. Gadenus states, in his "Historia Erfordiensis" (1675), that Basilius was living at St. Peter's convent at Erfurth in 1413, but the earliest copy of the "Testamentum," which is a French translation in manuscript, is dated 1651, and the book was not printed until about fifty years after Agricola. The other account is contained in "De natura rerum," IX, by Paracelsus, which was no doubt written prior to "De re metallica," for Paracelsus died in 1541, but it was not published until some time later. From this account Hoover[1] quotes:

> These [divinations] are vain and misleading, and among the first of them are divining rods, which have deceived many miners. If they once point rightly they deceive ten or twenty times.

Barrett[2] considers it practically certain that the birthplace of the modern divining rod is in the mining districts of Germany, probably in the Harz Mountains, where the most approved mining processes were first devised. He says:

> Possibly they were led to its use from the belief, once universal among educated men like Melanchthon, that metallic ores attracted certain trees which thereupon drooped over the place where those ores were to be found, the drooping no doubt being due to the soil or other causes. A branch of the tree was therefore cut and held to see where it drooped; later on a branch was held in each hand and the extremities tied together, as shown in an old Italian plate [See fig. 4]; finally, for convenience, a forked branch was cut, the two ends grasped one in each hand with palms upward; the arms of the holder were then brought to the side of the body, so that the forked rod was held in somewhat unstable equilibrium, and the "diviner" set forth on his quest with, in old time, certain solemnities and invocations.

At any rate the divining rod came into common use first in Germany as a means for locating mines and also for discovering buried treasure, a matter of rather common interest in those days, when the practice of burying money and plate for safe keeping was so general.

SPREAD OF THE DELUSION.

German miners were imported into England during the reign of Elizabeth (1558–1603) to lend an impetus to the industry in Cornwall, which had been passing through a period of depression. By them the divining rod was introduced into England, and before the end of the seventeenth century it had spread through the countries of Europe. Everywhere it aroused controversy. Its champions, among

[1] Hoover, H. C. and L. H., Agricola, De re metallica, p. 38, 1912.
[2] Barrett, W. F., Soc. Psych. Res. Proc., vol. 13, p. 13, 1897–98.

whom were some of the most learned men of the time, explained its operation, as, indeed, they explained nearly all facts of physics and chemistry, on the principle of "sympathy" or "attraction and repulsion." The common phenomena of gravity and magnetism doubtless suggested this interpretation. Philippe Melanchthon, in his "Discours sur la sympathie," 15—?; his son-in-law, Gaspar Peucer, in "Les devins," 1584 (book 13, ch. 10); Porta, in "Magiae naturalis,"

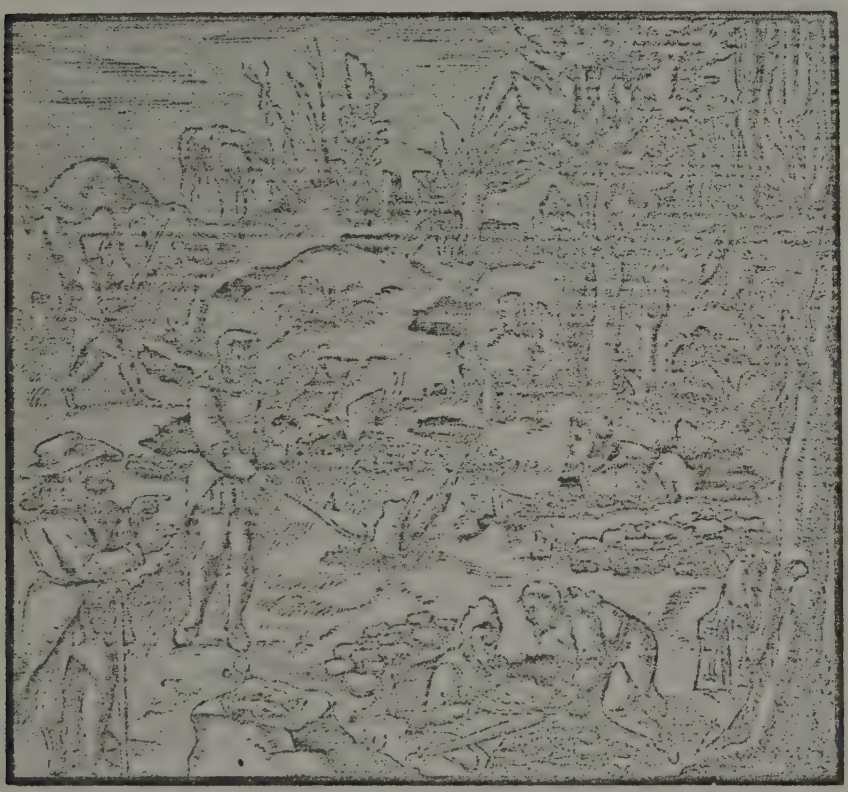

FIGURE 4.—Use of divining rods in prospecting for ore. A, Twig; B, trench. (From Agricola, De re metallica, German edition, 1580.)

1569 (book 1, ch. 8); Keckermann (1573–1609) in "Systemata physica" (book 1, ch. 8); and Michel Mayer, in "Verum inventum," 1619 (ch. 4), attribute the action of the divining rod to "sympathetic affinity."

The adversaries of the divining rod, on the other hand, like Paracelsus and Agricola, condemned its use as a superstitious and vain practice, without attempting to refute the specific arguments advanced by their opponents or flatly denying its supernatural connections.

A third view was that involving a demoniac influence, and Raymond suggests that the adversaries of the rod, including Agricola,

may have adopted their attitude of reserve on the question of Satanic influences from a desire to avoid possible serious consequences. Another view, closely related to that of satanic influence, is described by Raymond [1] as follows:

A fourth view was indeed advanced, according to which the operator, as well as the rod, was the recipient of a divinely given faculty. It was no doubt with the purpose of avoiding the odium attached to dealings with the Evil One that the professors of this science, particularly in Germany, surrounded it with ceremonies and formulas of a highly pious character. It is true that the rules sometimes prescribed for the cutting of the twig partook largely of heathen sorcery and astrology. They were indeed, to some extent, unconscious reminiscences of the old Scandinavian, and even of the Aryan mythology. But this was atoned for when the rod was duly Christianized by baptism, being laid for this purpose in the bed with a newly baptized child, by whose Christian name it was afterward addressed. The following formula, cited by Gaetzschmann, may serve as an example: "In the name of the Father and of the Son and of the Holy Ghost, I adjure thee, Augusta Carolina, that thou tell me, so pure and true as Mary the Virgin was, who bore our Lord Jesus Christ, how many fathoms is it from here to the ore?" In this case, the rod was expected to reply by dipping a certain number of times, corresponding to the number of fathoms,

It is readily conceivable that the motive for surrounding this practice with a religious atmosphere might not have been altogether a belief in its divine character, for at that time anyone found engaged in mysterious works was in danger of being charged with sorcery and burned to death.

In Cornwall the belief was common among the miners and still persists as a tradition, that the divining rod was guided to the ore deposits by the pixies, the fairy custodians of the mineral treasures of the earth.

Not only did the abstract discussion of this subject engage the attention of persons in all classes of society, but nobles and peasants, priests and philosophers—representatives from every class—busied themselves trying to locate ore deposits by means of forked twigs. Probably the most prominent diviners at this time were Baron de Beausoleil (Jean-Jacques de Chatelet), 1576–1643, and his wife. Beausoleil, who was one of the foremost mining authorities of his day, traveled extensively through the mining regions of Europe, visited America in his study of mining, and received important commissions from dukes and emperors, and even from the Pope. His wife shared his responsibilities and honors. But later they fell from favor through the machinations of rivals, and the fact that they used divining rods and other contrivances was made the basis of a charge of sorcery. After some years of persecution they were placed in prison (1642), the baron in the Bastile and his wife in Vincennes, where they died about 1645. Raymond [2] writes:

In magnifying the art of discovering mines and springs, and the skill required for this purpose, she [the baroness, in "The restitution of Pluto"] gives a description of

[1] Raymond, R. W., The divining rod: Am. Inst. Min. Eng. Trans., vol. 11, p. 419, 1883.
[2] Idem, pp. 420–421.

the means employed, showing that these hidden treasures are to be detected, (1) by digging, which is the least important way, (2) by the herbs and plants which grow above streams of water, (3) by the taste of the waters which flow from them, (4) by the vapors which arise from them at sunrise, and (5) by the use of 16 scientific instruments and 7 rods [the 7 rods of Basilius Valentinus] connected with the 7 planets," etc.

The first four means were undoubtedly real and really employed. Under the fifth head we have an illustration of what is so common in the alchemistic and other medieval writers, namely, the covering of the facts of nature and the methods of investigation with assumed mystery to hide them from the vulgar.

This raises the interesting question as to the extent to which intelligent persons may have used divining rods in the early days for the sole purpose of concealing from the uninitiated their real methods of prospecting. One can hardly overestimate the respect for the divining rod that would be created among common miners if a man of real ability publicly attributed his success to its use, and it may be that the deep-rooted hold which the superstition obtained on the popular mind was due to just such circumstances as this.

ORIGIN OF "WATER WITCHING."

The above quotation from the Baroness Beausoleil is interesting also for the reason that in it the divining rod is mentioned as a means of discovering springs. The Beausoleils are believed to have been influential in bringing about the use of forked twigs in searching for water, although Barrett [1] writes as follows in regard to an account which he finds in a Life of Saint Teresa of Spain:

Teresa in 1568 was offered the site for a convent to which there was only one objection—there was no water supply; happily, a Friar Antonio came up with a twig in his hand, stopped at a certain spot, and appeared to be making the sign of the cross; but Teresa says, "Really I can not be sure if it were the sign he made, at any rate he made some movement with the twig and then he said, 'Dig just here'; they dug, and lo! a plentiful fount of water gushed forth, excellent for drinking, copious for washing, and it never ran dry."

Barrett regards this the first historical reference to "dowsing" for water, but Mager [2] and Klinckowstroem [3] mention a paper written by Claude Galien in 1630 on the supposed discovery of the Chateau-Thierry mineral water by Baroness Beausoleil as the first reference. At any rate, from about this time on the divining rod was used in southern Europe as much in the search for water as in the search for mines, although, according to Barrett, it was not used for this purpose in England until near the end of the eighteenth century.

This new application of the divining rod no doubt tended to popularize it. It had been of interest chiefly to miners, and outside of mining districts it was probably known only in a vague sort of way. But as a "water finder" it became more generally known,

[1] Barrett, W. F., Psychical research, p. 171, 1911.
[2] Mager, Henri, Les moyens de découvrir les eaux souterraines et de les utiliser, p. 327, 1912
[3] Klinckowstroem, Graf Carl v., Bibliographie der Wünschelrute, p. 38, 1911.

and in the very nature of things its successes must have outnumbered its failures, just as, taking the country over, successful wells outnumber unsuccessful ones.

ECCLESIASTICAL CONTROVERSIES.

The divining rod continued to be a favorite subject with alchemistic writers until about 1660, when a new turn of affairs was brought about largely by the Jesuit Father Gaspard Schott, who, in his "Magiae universalis naturae et artis" (1659), denounced it as an instrument controlled by the devil. The subject was then taken up by the church, and for more than 100 years it was hotly debated by churchmen. Some approved of the rod and authorized its use on church property; others condemned it and threatened those who used it with excommunication. Gaspard Schott later expressed the belief that its movements were probably not caused by the devil, as "monks of great piety have used it with really marvelous success, and affirm positively that the movement is entirely natural and that it does not at all proceed from dexterity or from the strength of imagination of him who uses it," and he and A. Kircher were the first to advance the theory that the movement of the rod is due to unconscious muscular action.

About 1671 Matthaeus Willenius published an account of the mercury wand, in which he stoutly defended the use of the divining rod, and two years later Jacques Le Royer announced that the material of which the rod is made is of little consequence, as he claimed to have obtained equally good results with rods made of wood, oxhorn, ivory, gold, or silver.

In 1674 the Jesuit priest Dechales wrote (in "De fontibus naturalibus"):

> There are two things which astonish me in this experience: Why this rod turns only in the hands of certain persons, and second, why this rod serves equally well to locate both underground streams and mines.

In 1675 J. C. Frommann, a doctor of medicine, ridiculed those who explained the movements of the rod as a sleight-of-hand trick, and compared the mystery of the rod with the mystery of reproduction. In 1684 another doctor of medicine (G. B. de Saint-Romain) explained the movements of the rod as due to emanations given off from minerals and underground streams.

USE OF THE DIVINING ROD IN DETECTING CRIMINALS.

Prior to 1692 the divining rod had been used in trying to locate minerals and water and possibly to some extent for other purposes. But in that year an incident occurred in southern France which added greatly to the notoriety of the divining rod and extended its field of operation into the moral world, in which, according to some

writers (p. 9), rods for divination had their origin. This incident, which is described in great detail by several writers,[1] was the apprehension and identification of a criminal through the agency of a peasant of Dauphiny named Jacques Aymar, who claimed the ability to trace fugitives by the use of divining rods.

Interest in this case was intense and widespread and called forth a large amount of literature. In commenting on the case Barrett[2] says:

> The other one, a hunchback, who was arrested, confessed the crime and was executed: the last person in Europe who suffered that terrible penalty of being "broken at the wheel." * * * Strangely enough the depositions made at the trial showed that Aymar was correct in every detail, witnesses testifying to the flight and halting places of the culprits in the very places Aymar had indicated. * * * Aymar became notorious throughout Europe. He was, however, subsequently somewhat discredited owing to his failure in some tests devised by the Prince de Condé.

But Raymond, in a decidedly more skeptical treatment of the matter, raises some illuminating questions in regard to Aymar's integrity. His comment on the work of Aymar[3] includes the following statements:

> This man, Jacques Aymar by name, was sent for—or rather it was not necessary to send for him, since he proved to be already on hand in the city by the time it was decided to engage his services. This fact is significant as giving the key to what turned out to be an extraordinary piece of clever detective work. A careful analysis of the numerous official and other records of this case shows it to be quite possible that the diviner had obtained important clues before he was publicly set to work. * * * The subsequent tracking of a hunchback would be no very difficult matter. * * * But this achievement of the rod, attested as it was by official records and by the public confession and execution of the criminal made a great sensation in France. * * * Aymar was called to Paris, where both the court and the savants interested themselves greatly in his mysterious powers. Many marvelous feats are reported of him there; but the shrewd and rigorous experiments of the Prince de Condé exposed the emptiness of his pretensions * * * As late as 1703 this man was employed during the civil war to point out with his divining rod Protestants for massacre, under the plea of punishment for crimes they had committed.

The belief that the divining rod was an instrument invented by Satan for the confusion of men was no doubt as old as the superstition itself, but, as previously indicated, it was greatly strengthened when in 1659 Gaspard Schott proclaimed that the rod was controlled by the devil, thereby identifying it with witchcraft and bringing it within the jurisdiction of the Church. Although the use of the divining rod differed essentially from witchcraft in many respects, nevertheless, in addition to its direct implication by its ecclesiastical adversaries, there was in some respects a very close relation between the two, as

[1] Baring-Gould, Sabine, Curious myths of the middle ages, p. 54, 1894. Mager, Henri, Les moyens de découvrir les eaux souterraines et de les utiliser, pp. 362–365, 1912.

[2] Psychical research, ch. 12, p. 172.

[3] Raymond, R. W., The divining rod: Am. Soc. Min. Eng. Trans., vol. 11, pp. 424–427, 1883.

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is suggested by the use of incantations in connection with divining, and to this relationship may be ascribed in some measure the strengthening of belief in the rod. The significance of this lies in the fact that witchcraft, at the time of the Aymar episode, had become a frenzy, and anything—even the simplest occurrences of everyday life—which by any stretch of the imagination could be suspected of implication with witchcraft, became a subject of discussion and the basis of firm opinions and beliefs.

In view of the prevalence of such beliefs as this reign of delusion implies, it is by no means difficult to account for the credence accorded to such claims as those made by Jacques Aymar. Moreover, considering the ordeals of torture inflicted on persons accused of crime to extract confessions, by a strange perversion called "voluntary," and often inflicted on the witnesses as well, and considering also the fact that a public execution was sometimes regarded as a highly diverting spectacle well worth some effort to bring it about, the testimony supporting the claims of Aymar, as repeated to us, combined even with the reported confession of the accused, falls far short of establishing the merit claimed by Aymar, or even the guilt of the hunchback who was executed.

In 1701 the Inquisition issued a decree against the further use of the divining rod in criminal prosecution, and this use of the device rapidly came to an end.

SCIENTIFIC CONTROVERSIES.

LEBRUN AND OTHERS.

For about 80 years after the decree by the Inquisition abolishing its use for the detection of criminals the divining rod continued to be a fruitful subject for debate among ecclesiastical authorities, among whom was Pierre Lebrun, who in 1692 first suggested the theory of "prior intention," but in 1780 it was dropped and received no further official recognition by churchmen. But the time was then ripe for controversies along an altogether new line, namely, the attempt to explain water witching as an electrical phenomenon. About this time the study of electricity was making great progress, especially through the work of Volta and Galvani, and the demonstration by Galvani that amputated legs of frogs could be made to twitch under the influence of electrical stimuli was at once misinterpreted by advocates of the divining rod as giving a scientific basis for water witching.

THOUVENEL.

The controversies relating to electrical phenomena were begun by Pierre Thouvenel, a physician to Louis XVI, who interested himself in another peasant of Dauphiny, Barthélemy Bleton, who, like Jacques Aymar, had acquired notoriety as a "hydroscope."

Bleton was born at Bouvantes, in Dauphiny, in 1750, or possibly a few years earlier, was brought up by charity in a monastery, and became a herdsman. The first manifestation of "hydroscopic" faculties in Bleton is described in the following paragraph quoted from Barrett,[1] who gives it as a translation from Thouvenel's correspondence dated at Dijon, April 14, 1781:

Bleton when 7 years of age had carried dinner to some workmen; he sat down on a stone, when a fever or faintness seized him; the workmen having brought him to their side, the faintness ceased; but each time he returned to the stone he suffered again. This was told to the Prior of the Chartreuse, who wished to see it for himself. Being thus convinced of the fact, he had the ground under the stone dug up; there they found a spring, which, I am told, is still in use to turn a mill.

Thouvenel heard of Bleton and chose him as a fit subject on whom to test his notions of "animal magnetism," and as a result published an elaborate essay which he called "Mémoire physique et médicinal, montrant des rapports évidents entre les phénomènes de la baguette divinatoire, du magnétisme et de l'électricité." The following account by Raymond[2] presents the principal facts in regard to Bleton's achievements in concise form:

In the first place, Bleton apparently did not profess to discover immaterial qualities or facts, but chiefly confined himself to the detection of running water. In the second place, he frankly avowed that the rod possessed no power in itself by virtue of its form or material, and that it was merely an index, outwardly exhibiting to the spectators his inward feeling. This feeling the doctor declared to be a tremor, attacking first the diaphragm and communicating itself through the body and hands to the rod. In the third place this tremor was found by Dr. Thouvenel to be weakened, though not destroyed, when Bleton was on a tree or ladder or another person's shoulder, instead of the ground, or when he touched electrified substances; but the tremor and also the movement of the rod were completely stopped when Bleton was insulated from the ground. Upon facts of this kind he based his electrical theory. I remark, by the way, that the observations and the theory of Mr. Latimer, in his recent work on the divining rod, already mentioned, recall in a striking manner the performances of Bleton and the theory of Thouvenel. Mr. Latimer claims to have made the new discovery that the effect of the divining rod is destroyed by insulating the practitioner, as, for instance, by placing him upon a platform supported by glass bottles. If he had known how thoroughly this claim had been examined and refuted, almost exactly 100 years ago, he would have had less faith in its novelty and value.

Thouvenel's book made no little sensation, and in 1782 Bleton was called to Paris, where a remarkable series of experimental tests were applied to him. A newspaper report of the day declares that in the presence of many thousands of spectators he followed a subterranean aqueduct in the garden of the Luxembourg for 15,000 yards without a mistake. The chief engineer of the waterworks is reported to have said that the trace was so accurate that if the maps of his office had been lost, Bleton's footsteps would have constituted a complete survey to replace them. It is just possible that the Journal de Paris was tempted to make a sensation of this case, and it is also quite possible that a keen observer might notice indications other than those of his own diaphragm, by which he could follow the line of buried pipes. A large number of experiments, more calmly reported, certainly do not sustain the

[1] Barrett, W. F., On the so-called divining rod: Soc. Psych. Res. Proc., vol. 15, p. 257, 1900.
[2] Raymond, R. W., The divining rod: Am. Inst. Min. Eng. Trans., vol. 11, pp. 431–433, 1883.

enthusiasm of this account. It was found, for instance, that Bleton often passed over running water, when blindfolded, without noticing it; and that when taken several times over the same course he would not point out accurately each time the spots which he had previously marked. For example, of 16 points once indicated, he recognized with the rod on the second round but eight and missed the other eight. A single point to which he was repeatedly brought blindfold he indicated three times and missed three times. Of seven channels of running water which he was made to cross repeatedly, he indicated one once in four times, another once in four times, and another once in three times, while still another, which he crossed in two spots, affected his diaphragm at one crossing and not at all at the other. The insulation experiment was repeated by a physician at Paris. At a point where Bleton's rod was powerfully affected by alleged subterranean water, he was mounted upon a stool with glass legs, and immediately the rod ceased to be affected. When the stool was removed, however, and he stood upon the ground, the rod resumed its sensitiveness. But Dr. Charles, who conducted this experiment, took occasion, while Bleton stood upon the stool, to bring the top, without his knowledge, into electrical communication with the earth by means of a good conductor, thus destroying the insulation completely, though the hydroscopist supposed it still to exist. Under these circumstances the rod remained inactive, and the destruction of insulation did not produce the slightest result. This was declared at the time to be a proof of Bleton's charlatanry; but, as we shall see hereafter, it is equally consistent with the hypothesis of unconscious mental and muscular action.

As a final test of Bleton's capacity as a hydroscopist, he was taken blindfold into the new church of Saint Genevieve, where there was known to be no water for 100 feet below the floor, the vaults, foundations, etc., actually extending all that distance below. Here he professed to discover at numerous points large and small streams of water. Thouvenel subsequently asserted that his protégé had been affected by currents of damp air circulating in the cellar, but this explanation was universally considered as a desperate attempt to maintain a theory already brought into discredit by experimental tests. Bleton, however, though he ceased to be seriously respected by impartial scientists, continued to receive much attention, and to do a thriving business, both in Paris and subsequently in the provinces. Here, however, he no longer worked blindfold or professed to see with his diaphragm. He proceeded like the ordinary water diviners, with open eyes, studying all the natural indications, and coming to his decisions with abundant leisure; and under the circumstances it, is beyond doubt that he rendered many valuable services to landed proprietors by successfully locating wells. In many cases, however, he failed entirely, and it is reported that even in those in which he succeeded, he was seldom right as to the depth at which water would be found or the quantity which would be obtained. It should be mentioned that in Dauphiny, where Bleton discovered a large number of springs, he was regarded with an esteem never given to Aymar and some other famous hydroscopists. In other words, the people who knew most about the art of discovering water pronounced Bleton to be a real expert, while they believed Aymar and Parangue to be more or less charlatans. A review of all the facts leaves little doubt that in Bleton's case there was an unusually large proportion of the skill of the prospector, combined with rather less than usual of the mysterious claims of the wizard.

At this time many diviners acquired notoriety, including Parangue and Pennet, of Dauphiny, and Campetti, of Italy, but their careers differed in no significant respect from that of Bleton. The feature of this time was the patronage of diviners by scientists and the attempt to apply hypotheses of animal magnetism and terrestrial electricity to the supposed operation of the divining rod.

CHEVREUL AND FARADAY.

During the first half of the nineteenth century the phenomena of "table turning" was introduced, and became so popular that it was often employed in drawing-room entertainments. During this time also the so-called "magic pendulum," which had persisted from antiquity as a rather obscure divining instrument, was popularized and an elaborate system of electrical hypotheses was based on its conduct. The magic pendulum consists of a finger ring, watch, piece of metal, or any other suitable weight, attached to the end of a cord and suspended from the hand. In ancient times it was used to forecast events by suspending it over a disk on the margin of which were the letters of the alphabet, the pendulum being brought to rest and held steadily until it finally began to swing, thereby pointing out various letters which formed or suggested the words of a prophecy. It is said to be fairly common as a toy at the present time and is still occasionally used seriously by superstitious people in this country. At the beginning of the eighteenth century it was being used, like the divining rod, in attempts to locate well sites, for which purpose it is still used to some extent. In 1812, however, Michel Eugene Chevreul made an investigation of the subject and concluded that the whole phenomenon was a result of involuntary muscular movements in the hand, induced by mental processes.

In 1854 Michael Faraday showed that table turning was due to involuntary muscular movements; and in the same year Chevreul, as a member of a committee appointed by the Academy of Science to investigate the divining rod and the magic pendulum, wrote with regard to the divining rod:

> It is evident to my eyes that the cause of the movement of the wand does not belong to the physical world, but to the moral world; I think that, in most of the cases in hand, in which the wand is held by an honest man who has faith in it, the movement is the consequence of an act of the mind of that man.

The foundation of the science of psychology was being laid at this time, and psychical phenomena were just beginning to be recognized in a new light. In the conclusions of Faraday and Chevreul, therefore, may be recognized the first application of those new conceptions of mental processes. This theory was finally elaborated in an exhaustive treatment of the subject by Barrett. (See pp. 22–23.)

LATIMER.

While all these investigations were being conducted in Europe the divining rod was enjoying a peaceful existence in the United States, forked twigs being used more or less in prospecting for water, oil, and other mineral deposits. But in 1875 Charles Latimer[1] read before

[1] Latimer, Charles, The divining rod: virgula divina baculus divinatoribus, water witching, Cleveland, 1875.

the Civil Engineers' Club of the Northwest an essay on "The divining rod," which was later published (1876) with additional notes, in which he undertook to prove that the operation of the rod depends on electrical currents transmitted from the ground through the body, inducing a magnetic field between the rod and the ground. He also explained a method by which he claimed to be able to determine the amount of water available and the depth at which it would be reached.

RAYMOND.

In 1883 R. W. Raymond [1] published his essay on "The divining rod," which contains a historical outline of the subject and a set of conclusions based especially on the works of Chevreul. It concludes with the following highly rhetorical epitaph on this venerable superstition:

> To this, then, the rod of Moses, of Jacob, of Mercury, of Circe, of Valentin, of Beausoleil, of Vallemont, of Aymar, of Bleton, of Pennet, of Campetti—even of Mr. Latimer—has come at last. In itself it is nothing. Its claims to virtues derived from Deity, from Satan, from affinities and sympathies, from corpuscular effluvia, from electrical currents, from passive perturbatory qualities of organo-electric force are hopelessly collapsed and discarded. A whole library of learned rubbish about it which remains to us furnishes jargon for charlatans, marvelous tales for fools, and amusement for antiquarians; otherwise it is only fit to constitute part of Mr. Caxton's "History of human error." And the sphere of the divining rod has shrunk with its authority. In one department after another it has been found useless. Even in the one application left to it with any show of reason it is nothing unless held in skillful hands, and whoever has the skill may dispense with the rod. It belongs, with "the magic pendulum" and "planchette," among the toys of children. Or, if it be worthy the attention of scientific students, it is the students of psychology and biology, not of geology and hydroscopy and the science of ore deposits, who can profitably consider it.

BARRETT.

In 1891 W. F. Barrett,[2] professor of physics in the Royal College of Science for Ireland, in the interest of the Society for Psychical Research, undertook a very laborious investigation of water witching, or dowsing, as it is called in England, and later published his results in two large volumes.

Barrett concluded that the movement of the rod or forked twig is due to unconscious muscular action arising from subconscious and involuntary "suggestion" impressed on the mind of the dowser, and that this subconscious suggestion may be merely an autosuggestion or a suggestion derived through the senses from the environment, but that in a certain number of cases it appears to be due to a subconscious perceptive power commonly called clairvoyance. His conclu-

[1] Raymond, R. W., The divining rod: Am. Inst. Min. Eng. Trans., vol. 11, pp. 411–446, 1883. Published also in U. S. Geol. Survey Mineral Resources, 1882, pp. 610–626, 1883.

[2] Barrett, W. F., On the so-called divining rod or Virgula divina: Soc. Psych. Res. Proc., vols. 13 and 15, 1897, 1901.

sions were therefore in a sense favorable to water witching, although completely refuting all claims that there is any physical relation between the underground water and the forked twig or its manipulator, and definitely relegating the subject wholly to the obscure realm of occultism with other varieties of fortune telling.

MAGER.

In all its weird history no more extravagant and absurd claims were ever made for the divining rod than those which are maintained at the present time by Henri Mager. (See p. 8.) Mager is an enthusiastic champion of divining rods, magic pendulums, and his own mechanical device for locating water and ores. His hypotheses are presented in his three elaborate volumes—"Les moyens de découvrir les eaux souterraines et de les utiliser," 1912; "Les sourciers et leurs procédés," 1913; and "Les influences des corps minéraux," 1913—and in his pamphlet "A new method for the study of mining fields and for finding ore embedded in deep ground," 1914. At almost every step in the advance of science and philosophy some one has attempted to explain the supposed operation of the divining rod by means of the latest scientific theories, and Mager's work is in accord with precedent. His claims are built on dicta or speculations in which use is made of the terminology of students of radioactivity and electromagnetism.[1]

RECENT INVESTIGATIONS.

It remains to be stated that there are several societies in Germany whose sole object is said to be the study of the divining rod, and that a subcommittee of the commission of scientific studies in the bureau of waters and forests of the department of agriculture of France was appointed in 1910 to investigate the subject and in 1914 was still investigating.

MECHANICAL WATER FINDERS.

About 1640 Baroness Beausoleil, in "The restitution of Pluto" (see p. 16), listed, among means of discovering mines and springs, the use of 16 "scientific instruments." This is the earliest reference to such instruments that has been discovered in the preparation of this report, and it is a matter of considerable interest that even at this early date a single prospector should manifest so wide an acquaintance with devices for finding water and ore. It is certain that Beausoleil's 16 were the forerunners of a prolific race. At least 24 patents of this nature are now on file in the United States Patent Office, but this is no index to the number which have been rejected and which have never been offered for patent in this country, not to mention foreign inventions.

[1] See Joly, J., Radioactivity and geology, 1909, and Bauer, L. A., The physical theory of the earth's magnetic and electrical phenomena: Terrestrial magnetism and atmospheric electricity, vols. 15 and 16, 1910, 1911.

Most of the present devices are magnetic or electrical instruments, which, taken together, cover almost every application of magnetism and electricity. They range from ordinary dip needles to telephones and devices using wireless waves. Among the most widely advertised instruments of this kind are W. Mansfield's "Patent automatic water and oil finders," Henri Mager's "Indicator of current ground water," and Adolf Schmids's "Device for detecting subterranean waters." Mansfield's instrument was denied a patent in the United States on the ground that it was anticipated by the patent of Adolf Schmids. Mager's instrument, which is described in all his publications (see p. 23), is admitted by him to be only a modification of Schmids's device.

In the letters patent[1] of the Schmids device it is stated that the apparatus will "indicate certain atmospheric changes, the nature and cause of which are not yet understood but which manifest themselves in a peculiar way in the neighborhood of the source and course of subterranean waters by rapid oscillations of the pointer of the device."

The instrument is described as a hollow glass cylinder having an axis around which is spirally wound a soft-iron wire in layers that are separated from one another by paraffined paper, and at intervals by layers of tin foil. The outside layer of the spool is covered with paper. The wire of this spool forms an open circuit. The end of the spool is covered with a glass dial plate having at its center a pivot on which a pointer or needle oscillates.

It is claimed that when the instrument is in the vicinity of a source or a stream of subterranean water the needle will after a time oscillate rapidly.

In the literature advertising its "automatic water and oil finders," circulated by the Mansfield Co., of Liverpool, England, the following claims are made:

> The principle on which the instrument works is the indicating of the presence of currents which flow between earth and atmosphere, and which seeking the path of greatest conductivity, are always strongest in the vicinity of subterranean water courses, the waters of which are charged with electricity to a certain degree. In taking observations, wooden pegs are placed at intervals of 20 paces in a direction usually southeast to northwest. The instrument is tried over each of these pegs in turn, and should the needle move on any one of them, tests are made all round it, and the spot where the greatest movement of the needle is obtained is where the boring should be made. If the needle does not move subterranean water does not exist under the spot where the instrument is fixed. * * * The instrument indicates water courses flowing underground in a natural state and not water pipes or sources that have sprung up to daylight.

Systematic magnetic observations have been made for about 70 years, and a complete magnetic survey of the earth, under the direction of the Carnegie Institution of Washington, has been in progress

[1] Patent No. 841188, Jan. 15, 1907.

for a number of years, but this survey has not yet disclosed the existence of local earth-air currents on which to base a method of utilizing such currents in determining underground conditions. In view of this lack of knowledge any invention based on the assumption that such currents exist, as, for example, the Schmid patent, is subject to the general criticism that it is unsound in principle, or at least that, like the divining rod, it can be subjected to no conclusive scientific test. The practical use of such instruments, moreover, seems to be incompatible with the known instability of the magnetic and electric state of the earth and the atmosphere, in which disturbances of greater or less degree are constantly taking place. Investigations[1] have shown that magnetic disturbance is nearly continuous; that an entirely undisturbed day is abnormal. Some magnetic disturbances are local; others affect the whole earth simultaneously.[2] Bauer[3] writes:

> The magnetic disturbances experienced by the earth are generally of a very complicated nature and reach at times startling magnitudes. Thus during the most remarkable magnetic storm of which there is any record—the one of September 25, 1909—the compass needle in the vicinity of the city of Washington suffered a change of 5 degrees in the short space of a quarter of an hour and the force acting on it passed through a change during the same period amounting to 10 per cent of its full value. * * *
>
> I confidently expect, as soon as a complete analysis has been made of magnetic disturbances covering the greater portion of the earth, it will be found that * * * the disturbances will themselves reveal effects from terrestrial, continental, regional, and even local causes (earth currents, for example, whose path and intensity depend upon local character of soil, etc.).[4]
>
> Since the earth's magnetic state is known to be of a very heterogeneous character, requiring an exceedingly complicated mathematical expression for even a very approximate representation, it may be confidently expected that any magnetic change or disturbance, from whatever source it may come and of however simple a type it may originally be, by the time it has entered the earth's field and has impressed itself upon our magnetic instruments, will have been converted into an equally complex type to that of the earth's magnetism itself.[5]

Further study of this subject tends merely to strengthen the belief that magnetic disturbances may be due to causes so many and various that no confidence can reasonably be placed in any claim that the oscillations of a magnetic needle indicate the occurrence of available ground water, much less the depth at which water can be reached or the quantity that can be obtained; and it confirms the opinion that, in the present state of knowledge, any such claim is purely speculative.

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[1] Bauer, L. A., Analysis of the magnetic disturbance of Jan. 26, 1903, and general considerations regarding magnetic changes: Terrestrial magnetism and atmospheric electricity, vol. 15, pp. 22, 24, and 25, 1910.

[2] Schuster, Arthur, The diurnal variation of terrestrial magnetism: Roy. Soc. London Philos. Trans., ser. A, vol. 208, pp. 184–185, 1908.

[3] Bauer, L. A., The physical theory of the earth's magnetic and electric phenomena: Terrestrial magnetism and atmospheric electricity, vol. 15, p. 111, 1910.

[4] Op. cit. (Analysis, etc.), p. 25.

[5] Idem, p. 22.

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